Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of	)	
	)	
LightSquared Petition for Declaratory Ruling	)	
	)	ET Docket No. 10-142
	)	IB Docket 11-109
	)	

DA 12-103

January 27, 2012

INTERNATIONAL BUREAU ESTABLISHES PLEADING CYCLE
FOR LIGHTSQUARED PETITION FOR DECLARATORY RULING

REPLY COMMENT – February 29, 2012

Commenter Background

Having spent my 35 year career in radio communications engineering, specifically focused on broadcasting and on wireless communications, I feel compelled to respond to the LightSquared petition. I was actively involved in the National Radio Systems Committee evaluation and standards setting process for the adoption of digital radio broadcasting technology in the USA. I have evaluated broadcast and non-broadcast radio stations, proposed and existing, for compliance with FCC interference protection standards. I have performed laboratory tests and field measurements relating to spectrum occupancy and interference. I have testified before Congress on interference matters relating to spectrum assignments. In addition to holding a General Class Radiotelephone License, I am certified by the Institute of Electrical and Electronics Engineers as an IEEE Wireless Communications Professional® and certified by the Society of Broadcast Engineers. I use GPS and terrestrial and satellite wireless services in my work. Due to a busy schedule and lack of resources to provide a fully annotated response, I beg the Commission's indulgence for this brief opinion in lieu of a fully cited analysis.

Simple Matter of Protection Ratios

In particular, I have skimmed the comments in this proceeding and I see that among the comments I have considered, no one is addressing the fundamental fact that spectrum is allocated and assigned with protection ratios among adjacent channels in mind. Even the January 26, 2011 Order and Authorization for LightSquared Ancillary Terrestrial Component (DA 11-133) is silent on the subject of protection ratios. It is perplexing that the Commission, which ought to be considered the most expert on the subject of ensuring that protection ratios are considered in making allocations and assignments, apparently did not even ask the question.

The Commission's obligations to provide for reasonable and consistent protection ratios among radio services on adjacent spectrum are implicit in all matters of allocation and assignment. It is well understood that the regulation of electromagnetic compatibility in the licensed spectrum includes not only the consideration of unwanted emissions in a licensee's licensed spectrum, but also consideration of the compatibility of emissions in nearby channels with the reception of emissions in the desired bandwidth.

Receiver Performance Is Implicit in Allocations

In short, the spectrum is regulated based on how receivers really work; spectrum cannot be regulated by demanding that receivers have perfect bandpass characteristics of only the desired channel. The Commission, under its mandate from the Communications Act of 1934 to maintain the integrity of the radio spectrum and prevent interference, must – and does – allow for the fact that receivers can be affected by strong undesired signals in adjacent channels.

Petition Ovelooks Role of Compatibility and Regulatory Certainty in Decisions

LightSquared's licensed spectrum is in the Mobile Satellite Service ("MSS") space-to-earth spectrum. LightSquared is acting in a vacuum of understanding regarding the manner in which radio spectrum is managed. LightSquared proposed to place an "off-label" use of terrestrial cell sites within the MSS allocation. This is a recipe for incompatibility. LightSquared seeks a ruling that would have the Commission abdicate its implicit role in ensuring the compatibility of adjacent uses of the spectrum. It has been the general practice of the Commission as well as the international community to allocate and assign radio frequency bands and channels in a manner that provides a degree of regulatory certainty with respect to interference and system compatibility. Spectrum assignees rely on knowing in advance what their neighbors will be doing.

The radio receiver is an implicit part of every radio frequency assignment, even when the Commission does not explicitly outline receiver performance criteria. Regulatory certainty regarding compatibility of spectrum use is provided by the use of protection ratios, both implicit and explicit. Protection ratios are limits which the strength of an undesired signal must not exceed in order to protect the reception of a desired signal. Radio receivers are designed with an expectation of a particular set of protection ratios for the service being received. Explicit protection ratios are generally codified within a particular service, to enable multiple users to share adjacent channels within the service.[1]

Satellite (especially mobile satellite) is Largely Segregated from Terrestrial for Good Reason

Implicit protection ratios are built into the Table of Allocations. Like uses are grouped in spectral bands. In the instant matter, LightSquared would have the Commission violate the sanctity of a broad swath of internationally recognized space-to-earth communications spectrum for a terrestrial use. The Table of Frequency Allocations, 47 CFR 2.106, shows that International Region 2 (including the USA) various space communications allocations begin at 1215 MHz, continuing to 1400 MHz, where it begins to be predominantly Space-to-Earth centric allocations. These space-to-earth allocations continue to 1610 MHz, where they continue to be space-oriented allocations (including earth-to-space components and passive components) up to 1668 MHz. Beginning at 1668 MHz, the allocations begin to mix fixed terrestrial uses with potential satellite uses. (The USA table does intersperse some land mobile allocations from 1390 to 1435 MHz.)

It is no coincidence that various space communications allocations are grouped in adjacent spectrum. Mobile satellite signals are quite feeble when they arrive in space from the ground and when they arrive on the ground from space. This manner of allocation of the MSS spectrum is an implicit interference protection model. The received power levels of space-to-earth communications will be in the same general magnitude on adjacent channels/bands. Receivers are designed with this implicit ratio between desired and anticipated undesired signal levels in mind. Such is the case with GPS receivers, which are designed and manufactured with an understanding that they are looking at a broad segment of space-to-earth spectrum. Sensitivity is not sacrificed if there are no strong undesired signals in adjacent spectrum. Relatively wide bandwidth receivers can be "de-sensed" by strong undesired signals on nearby channels.

[1] Broadcast facilities are placed geographically based on protection ratios with the same channel and several adjacent channels. Distance separation requirements are derived from protection ratio analysis. Land mobile facilities must meet protection ratio criteria with their neighbors. Cellular-style communications have obligations to limit their power levels at the boundaries of their service areas to protect neighbor licensees. These provide users of the spectrum with regulatory certainty that within their protected service areas, undesired signals on adjacent channels will generally remain at levels within which real-world receivers will work properly.

Likewise, narrow bandwidth receivers can lose sensitivity due to the losses in the filters and the distortions of the incoming desired waveforms caused by narrow filters.

Ignoring Incumbent Receivers Is Bad for the Marketplace

The consequences of breaking from the interference protections implicit the collective satellite band allocations are several. First, assignment of a terrestrial use in the space-to-earth segment of MSS contributes to the erosion of marketplace confidence. System developers will lose confidence that a substantial investment in spectrum and technology will be protected from regulation-induced incompatibility in the future. The marketplace will find products rendered obsolete by spectrum incompatibility rather than by market evolution. Second, commendable as this proposal might appear from a spectrum efficiency perspective, it would be a blow against spectrum diversity. Cellular-style communications have shown themselves to be a highly efficient use of spectrum through the principle of frequency reuse. If such communications are allowed to erode and invade incompatible spectrum allocations, the entire spectrum migrates to a one-size-fits-all model of spectrum use- cellular communications. The Commission has worked to maintain diversity of spectrum uses while creating opportunities for expanding cellular-style spectrum use. The MSS space-to-earth segment is no place to begin farming a terrestrial service.

Mobile Satellite Reception Constraints Cannot Be Ignored

Mobile satellite service is burdened with two critical characteristics, from a compatibility point of view. First, being mobile, the use of directional antennas is not practical.[2] Mobile devices lack the interference reduction that a directional antenna can provide. Second, the signal levels arriving from very distant satellites are quite feeble. A mobile satellite receiver must be sensitive to such weak signals without the aid of high gain antennas. By allotting several mobile satellite services side by side in a group of frequencies, the desired-to-undesired signal ratios in adjacent bands are maintained at a consistent and predictable level. In the way the bands are allocated, the disparity of a high power terrestrial signal adjacent to a feeble satellite signal is avoided.

SDARS Not Analogous

Anyone who might raise the issue of SDARS terrestrial repeaters as an example of how to address the instant issue would be overlooking the significant difference in circumstances. SDARS is assigned spectrum that is not designated Mobile Satellite Service by the ITU or in the USA. The 2300-2450 MHz

[2] GPS, which requires simultaneous tracking of numerous satellites in motion throughout the sky, simply cannot rely on a high-gain directional antenna. (Not to mention the cost and portability issues that burden any mobile service if a large directional antenna and tracking device are required)

spectrum is designated quite generically as Fixed, Mobile, Radiolocation and Amateur (47 CFR 2.106). SDARS spectrum (2320-2345) is designated Broadcasting-Satellite in the USA. It is flanked by Wireless Communications Service ("WCS") spectrum, a terrestrial service, by definition.

Further, the concerns about SDARS/WCS adjacent spectrum compatibility were raised to protect a terrestrial service (WCS) from terrestrial repeaters (S-DARS) in an adjacent band. Desired and adjacent undesired signals are likely to remain within a few orders of magnitude of each other. The only satellite service involved in the question was SDARS, the installer of the repeaters. SDARS knew in advance that it was putting a satellite service in spectrum surrounded by terrestrial services. SDARS also planned in advance to mix a terrestrial component with their satellite component. Consequently, SDARS signals (the "air interface" technology) and SDARS receivers are designed to be robust in the presence of strong terrestrial signals in adjacent spectrum. SDARS is not GPS.

To address the WCS concerns about compatibility of SDARS terrestrial repeaters, 47 CFR 25.263 was adopted, requiring SDARS licensees to give advanced notice of new terrestrial repeaters to, and cooperate with, WCS licensees. Terrestrial WCS received a guarantee of transparency and cooperation in the final adoption of the 2010 terrestrial SDARS regulations. Terrestrial-to-terrestrial interference to WCS receivers adjacent to SDARS is very unlikely, and the transparency enables the licensees to be certain, if a question should arise.

The key distinction between the SDARS terrestrial repeater issue and the LightSquared matter, then, is that the manner in which the spectrum is allocated and assigned creates a design expectation on the part of system developers. WCS developers were already dealing with spectrum in which there would be a significant terrestrial component (their own spectrum). The addition of SDARS terrestrial repeaters was a minor adjustment to the use of the nearby terrestrial spectrum. In contrast, MSS and nearby satellite spectrum users have enjoyed having adjacent bands that are assigned for similar purposes, to which the addition of a terrestrial component fosters significant incompatibility and voids the regulatory certainty of the MSS allocations.

Protection Ratios Are Maintained to Protect Incumbent Receivers

The broadcast spectrum is another case in point. The Commission adopted *protection ratios* not only for co-channel signals, but also for signals in nearby channels. Protection ratios between adjacent services were also maintained (e.g. NCE FM to TV channel 6 protections). Protection ratios are common currency

in radio frequency allocations and assignment in the USA and under the auspices of the International Telecommunications Union.

Relying on the protection ratios for a particular radio service, device manufacturers develop receiver products that are generally conformal to the expected *desired-to-undesired signal ratios* on the same and adjacent channels. Users of the radio spectrum have a degree of regulatory certainty because the protection ratios are established at the outset and maintained.

In the broadcast environment, for example, protection ratios are modified over time in light of the existing base of reception devices and the state of the art and the state of the understanding of interference modalities. The history of modifications to the services and protections in the FM radio spectrum is an excellent example. In the matter of Low Power FM service, considerable scientific work was performed by all parties to assess the potential impact of LPFM assignments that might be granted an exception to the traditional and conventional protections (in which protection ratios are either actual signal level ratios or are translated to separation distances based on station classifications.) The installed base of receivers was considered by all parties as the point of reference for considering any modifications of the protection ratios for LPFM service.

Similarly, iBiquity Digital Corporation, the licensor of HD Radio™ technology and the National Radio Systems Committee went to great effort to develop, evaluate, and standardize an in-band digital radio broadcasting technology that would be compatible with the installed base of receivers. HD Radio broadcasting is consistent with the protections already afforded by the long-standing protection ratio rubric.

Similar Incompatibility in a Land Mobile Service Required Spectrum Refarming

The use of Specialized Mobile Radio frequencies for personal wireless services was the subject of a protection ratio problem. Traditionally, public safety communications frequencies could expect that other users of the same general spectrum, such as SMR, would have wide area coverage from repeater sites and base stations. The tremendous increase in the number of sites used by the Nextel SMR service in a cellular fashion broke the mold. Public safety communications near these cellular sites were sometimes overwhelmed by the high levels imposed on the receiver from a nearby SMR cell site, while the public safety base station was some distance away. This incompatibility of services was an accident of the nature of cellular communications as it evolved, while the public safety communications retained a non-cellular, wide area configuration. The solution to this problem was not to demand that all public safety

communications devices be replaced with better-filtered units (as LightSquared's approach would suggest). Instead, there was a refarming of spectrum to eliminate this unintended consequence.[3]

Conclusion

In summary, the Commission has traditionally conducted its affairs in a manner to protect existing devices under existing protection ratios when contemplating changes to the use of spectrum. The Commission also relies on the real-world performance of receivers in the marketplace when establishing protection ratios and generally does not mandate receiver performance criteria. LightSquared's request that the Commission abdicate consideration of the real-world performance of GPS receivers in its deliberations is contrary to the Commission's responsibility and practice.

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[3] cf. "Over the past two years, Nextel has worked with the public safety community to identify why CMRS operations are interfering with public safety communications systems in the 800 MHz band, even though all licensees are in compliance with the Commission's rules and the terms and conditions of their licenses. Typically, interference occurs in the immediate vicinity of CMRS base stations operated by either the cellular licensees or advanced SMRs using digital, cellular-like network architecture. Public safety communications operators in about 25 metropolitan areas have experienced this type of interference, often near multiple CMRS base stations. Interference can disrupt critical life safety communications with police officers, firefighters, rescue teams and other emergency response personnel, potentially putting them at risk as well as the public they serve. Mitigating these risks is essential and has become even more urgent in the aftermath of the September 11, 2001 terrorist attacks on our country.

Last January, Nextel and the Association of Public Safety Communications Officials, Motorola, Inc., the Cellular Telecommunications and Internet Association and the Public Safety Wireless Network presented to the Commission a "Best Practices Guide" that identified the causes of CMRS – public safety interference and presented both mitigation alternatives and prior coordination plans to prevent interference. As discussed therein, **the fundamental cause of this interference is an 800 MHz spectrum allocation plan, initially adopted in 1974, that has failed to keep pace with the dynamic nature of the wireless telecommunications marketplace. It results in the Commission authorizing public safety communications providers and CMRS licensees to operate essentially incompatible systems on mixed, interleaved and adjacent 800 MHz channels. The locally stronger transmissions of CMRS systems "overpower" less robust, distant public safety signals** -- a signal strength disparity that under certain circumstances causes interference in the front end of public safety receivers. Intermodulation is the dominant cause of interference, with wideband noise and receiver overload playing a secondary role." **[emphasis added]**
--Nextel Communications, Inc letter to FCC Wireless Telecommunications Bureau, November 21, 2001.